CLAIMS

WHAT IS CLAIMED IS:

1. A method for manufacturing shot useful for discharge from a shotgun comprising:

providing a source of molten steel having an initial carbon content;

subjecting the molten steel to an atomization process so as to produce substantially spheroidal pellets;

annealing the pellets in a decarburizing atmosphere effective to decrease the carbon content in at least a surface layer of each of the pellets; and

cooling the pellets, whereupon, on average the surface layer has a median Knoop hardness of less than 225 at 21°C.

2. The method of claim 1 further comprising packaging the pellets in packages labeled as for use in loading shotshells.

3. The method of claim 1 further comprising loading the pellets into shotshells.

4. The method of claim 1 wherein the atomization process comprises water atomization.

5. The method of claim 1 wherein the surface layer is at least 0.1 mm thick.

6. The method of claim 5 wherein the surface layer is at least 0.3 mm thick.

7. The method of claim 1 wherein the surface layer has a thickness of at least 1% of an average diameter of the associated pellet.

8. The method of claim 7 wherein the surface layer has a thickness of 5%-10% of an average diameter of the associated pellet and the carbon removal is effective to provide the surface layer with a Knoop hardness of less than 225 at 21°C over substantially the entire surface layer.

9. The method of claim 1 wherein the core region has an average diameter of at least 50% of an average diameter of the associated pellet.

10. The method of claim 1 wherein the carbon removal is effective to provide the surface layer with a Vickers hardness of no more than 180 at 21°C over a majority of the surface layer.

11. The method of claim 10 wherein the carbon removal is effective to provide the pellets with a Vickers hardness of between 130 and 180 at 21°C substantially throughout.

12. The method of claim 1 wherein the spheroidal pellets have characteristic diameters between 0.08 inch and 0.23 inch.

13. The method of claim 12 wherein the pellets are #4 pellets and the subjecting step produces additional pellets and the method further comprises separating the additional pellets from the #4 pellets prior to the annealing step.

14. The method of claim 1 wherein the annealing leaves sufficient carbon in a core region of each pellet so that a majority of the core region has a Vickers hardness of more than 200 at 21°C and the carbon removal is effective to provide the surface layer with a Vickers hardness of between 130 and 180 at 21°C over a majority of the surface layer.

15. The method of claim 14 wherein prior to annealing the pellets have a combined manganese and silicon concentration of at least 0.8% by weight.

16. The method of claim 14 wherein prior to annealing the pellets have a composition by weight of :

0.85-1.2% carbon;

0.4-1.2% manganese;

0.4-1.5% silicon; and

remainder iron with up to 1% additional components.

17. A method for efficient manufacturing of shot for discharge from a shotgun comprising:

providing a source of molten steel;

subjecting the molten steel to an atomization process so as to produce particles;

segregating the particles into a plurality of groups based upon at least one parameter of particle size and particle shape, said plurality of groups including:

at least one ballistic group predominately designated for ballistic use wherein the particles are substantially spheroidal pellets having characteristic diameters between 0.08 inch and 0.23 inch; and

at least one industrial group predominately intended for industrial use;

annealing the pellets of the ballistic group in a decarburizing atmosphere effective to remove carbon from at least a layer of each of said spheroidal pellets; and

allowing the pellets to cool, the carbon removal being effective to, on average, provide the layer with a Knoop hardness of less than 225 at 21°C over a majority of the layer.

18. The method of claim 17 wherein:

the segregating includes:

segregating a plurality of such industrial groups of particle size and shape useful as industrial shot, leaving a first remainder of particles; and

segregating said at least one ballistic group from said first remainder of particles, leaving a second remainder of particles.

19. The method of claim 18 further comprising:

crushing at least part of said second remainder to form industrial grit useful for grit blasting.

20. A method for manufacturing a shotshell comprising:

obtaining a plurality of shot pellets formed by casting of molten steel and a subsequent annealing process; and

loading said plurality of shot pellets into a shotshell which further comprises:

a hull;

a propellant charge in a powder chamber within the hull;

a primer carried within a base of the hull; and

wadding between the propellant charge and the plurality of shot pellets.

21. The method of claim 20 wherein:

the plurality of shot pellets are formed by water atomization of molten steel and a subsequent carbon removal process, on average leaving such pellets with a surface Knoop hardness of less than 250 at 21°C.

22. The method of claim 20 wherein the pellets have a composition by weight of :
0.85-1.2% carbon;
0.4-1.2% manganese;
0.4-1.5% silicon; and
remainder iron with up to 1% additional components.

23. The method of claim 20 wherein the annealing is effective to provide the pellets with a surface hardness of less than 325 DPH.

24. The method of claim 20 wherein the pellets have a composition by weight of:
0% to 1.5% carbon;
0.1% to 2.0% silicon;
0.4% to 2.0% manganese;
no more than about 3% additional material; and
balance iron.

25. The method of claim 20 wherein:
the pellets have a silicon content from 0.40% to 1.50% by weight.

26. The method of claim 20 wherein:
the pellets have a silicon content from 0.8% to 1.2% by weight: and
the pellets have a manganese content from 0.5% to 1.2% by weight.

27. The method of claim 20 wherein:
the pellets have a carbon content from about 0.01% to about 0.15% by weight.

28. The method of claim 20 wherein the pellets have a combined silicon and manganese content of at least 0.8% by weight.

29. A method for manufacturing a shotload for discharge from a shotgun comprising the steps of:
providing a source of molten steel;

subjecting the molten steel to a water atomization process so as to produce substantially spheroidal pellets, each having a characteristic diameter (D) in inches;

annealing the spheroidal pellets; and

cooling the pellets, whereupon on average at least a surface layer of each of the spheroidal pellets has a median Vickers hardness (H) of less than (300+((D-0.1)(-2000))) at 21°C.

30. The method of claim 29 wherein the annealing comprises annealing the spheroidal pellets in a decarburizing atmosphere effective to decrease the carbon content in the surface layer of each of the spheroidal pellets.

31. The method of claim 29 wherein D is between 0.08 inch and 0.23 inch.

32. The method of claim 29 wherein prior to annealing the pellets have a composition by weight of :

0.85-1.2% carbon;

0.4-1.2% manganese;

0.4-1.5% silicon; and

remainder iron with up to 1% additional components.

33. The method of claim 32 wherein H is less than (275+((D-0.1)(-1900))) at 21°C.

34. A method for manufacturing a shotload for discharge from a shotgun comprising the steps of:

providing a source of molten steel;

subjecting the molten steel to a water atomization process so as to produce substantially spheroidal pellets;

annealing the pellets; and

cooling the pellets, whereupon on average at least a surface layer of each pellet has a median Vickers hardness of less than 200 if such pellet is #4 size or larger and a Vickers hardness of between 200 and 300 if such pellet is smaller than #4 size.

35. The method of claim 34 wherein the pellets are between #9 size and T-size, inclusive.